Brüel & Kjær

Portable Graphic Level Recorder

Type 2306

Valid from serial no. 859025

037—0213

Service

Portable Graphic Level Recorder

Type 2306

Valid from serial no. 859025

037 – 0213

Consisting of

Modifications

Due to the constant technical progress the instrument will be modified from time to time in order to provide continously improved performance.

For this reason there may be small differencies between the instrument and the Service Instruction.

However, the local Representative Service is in possession of all information regarding the modifications that have been made.

Spare Parts

Please state type and serial number of the instrument when ordering spare parts.

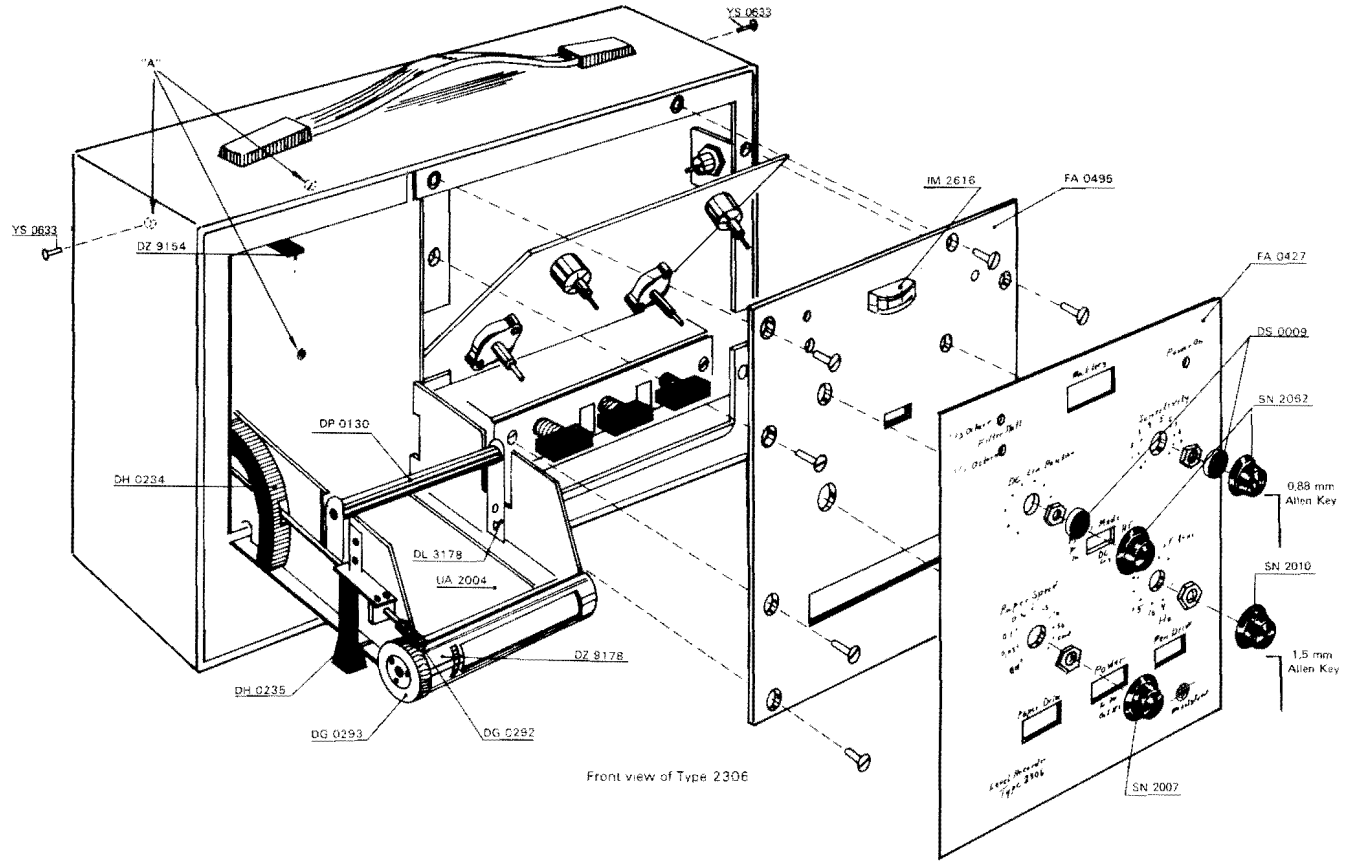
Trouble Shooting

If any faults should occur please check the instrument according to the Adjustment Procedure.

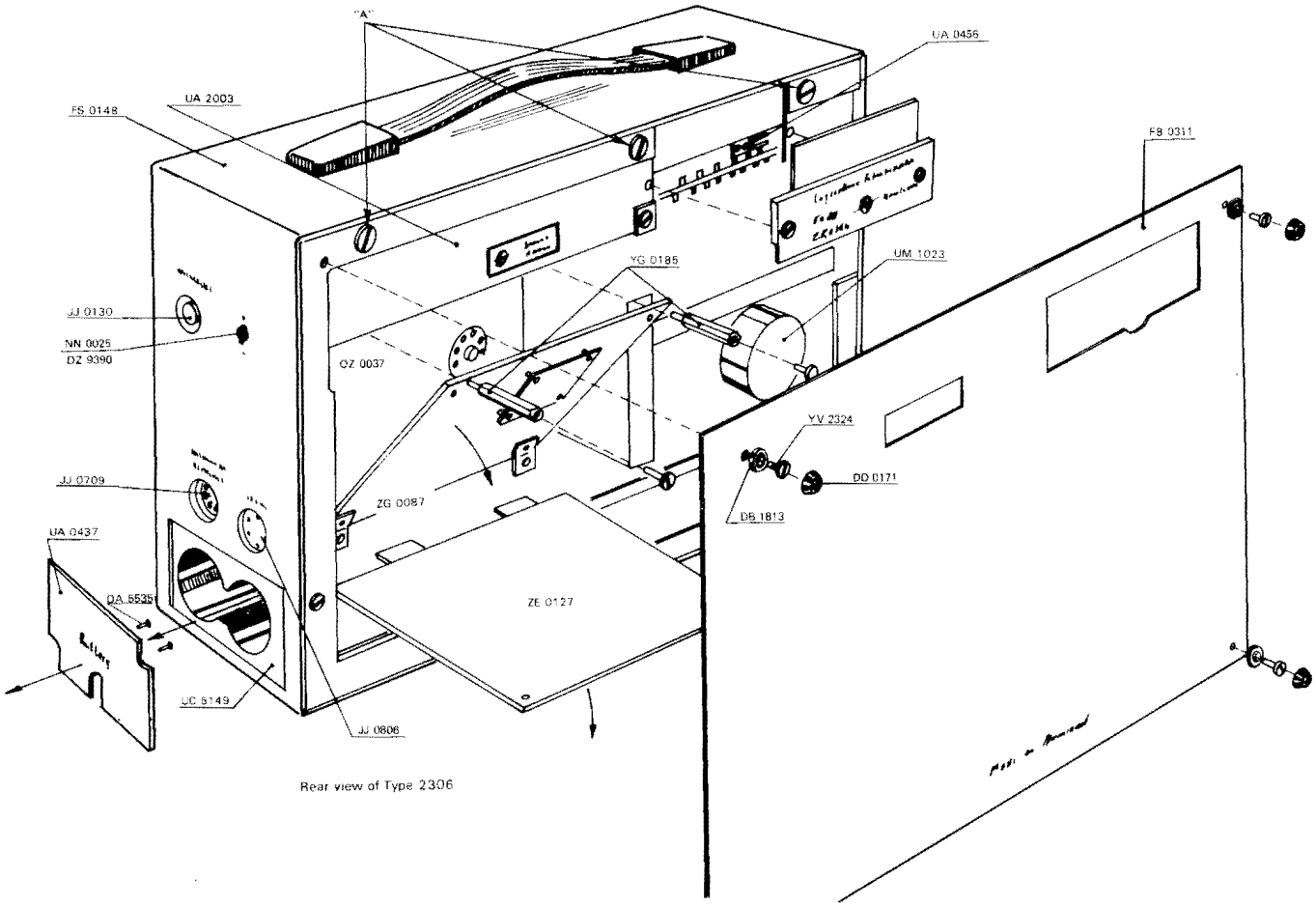
When a fault has been traced and corrected, the voltages and adjustments influenced by the correction must be rechecked. The complete instrument should then be tested according to the Adjustment Procedure to make sure that all basic functions are operative.

The tolerances given in these notes are intended for use as a guide for adjustments.

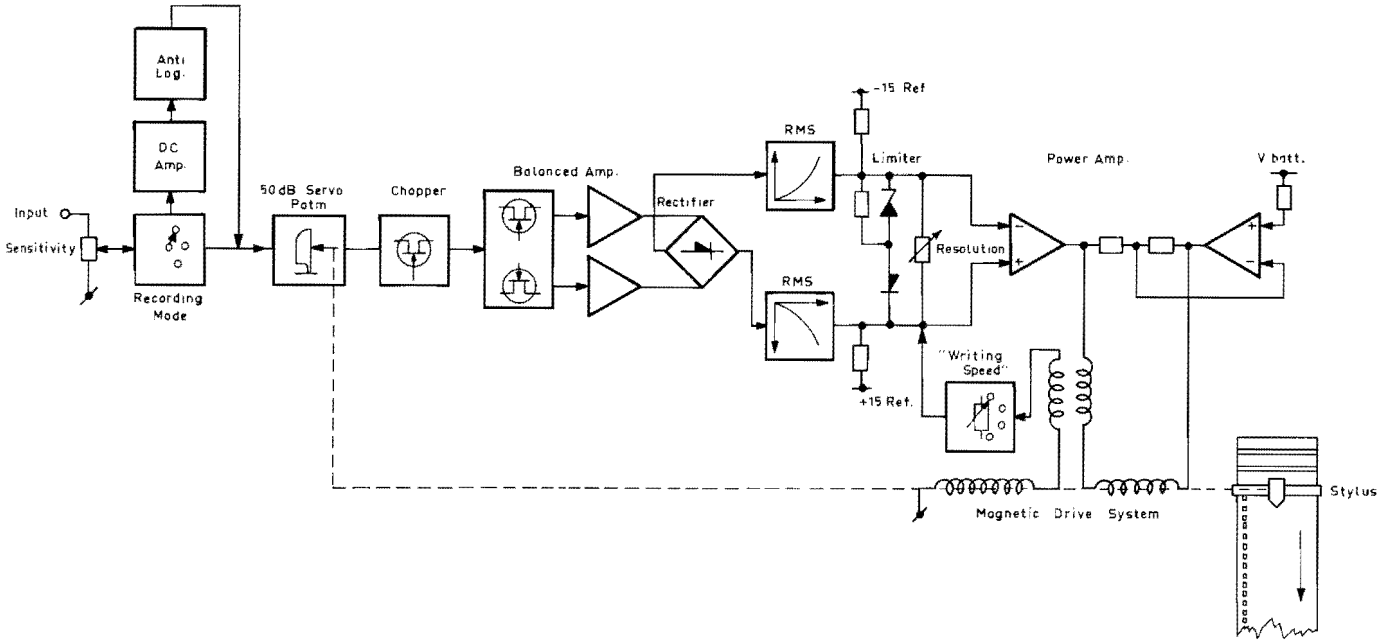
Before correcting any apparent deviation make sure that the measuring instrument has tolerances small enough not to affect the measurements.



Front view of Type 2306



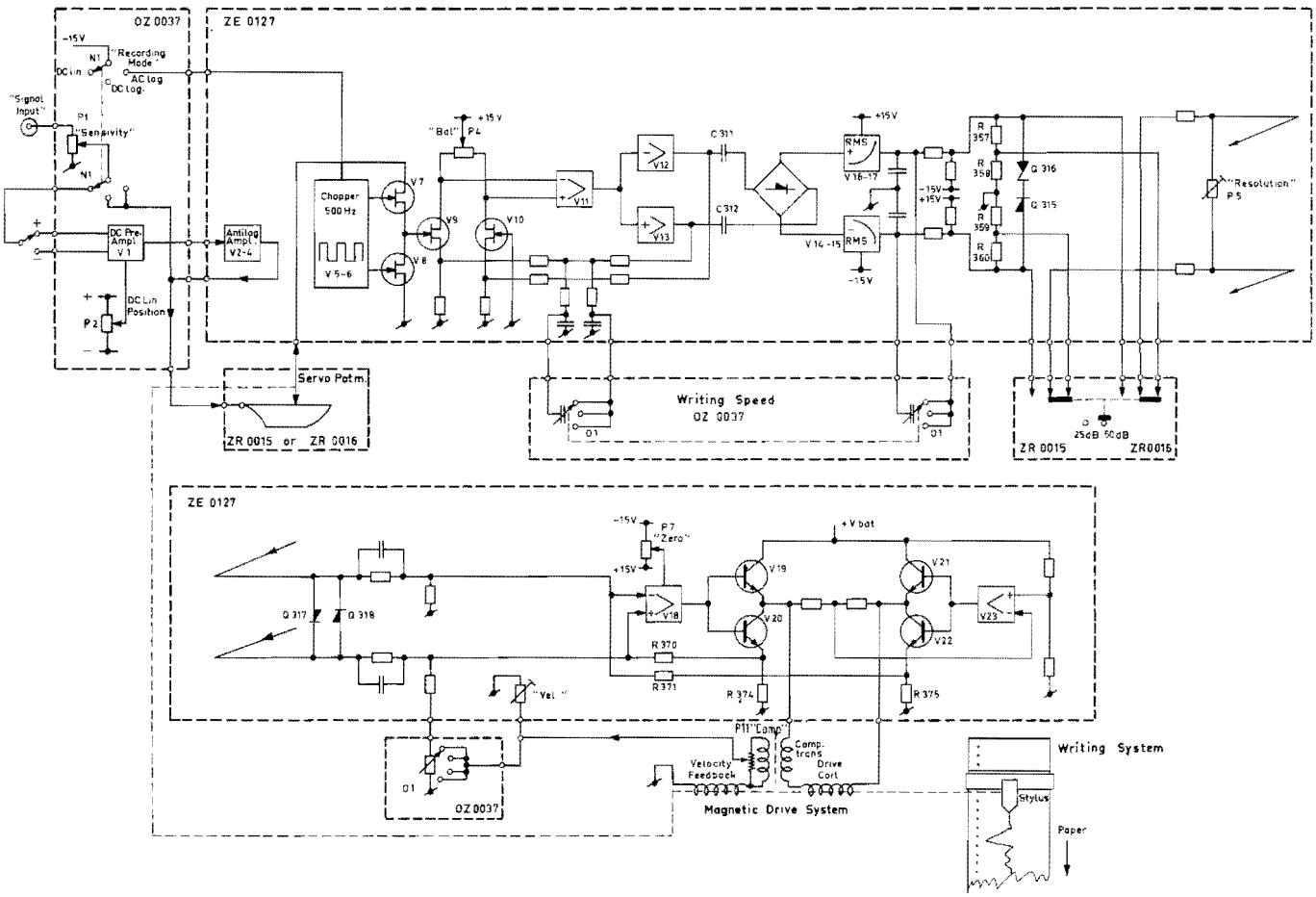
Rear view of Type 2306



The Level Recorder Type 2306 consists mainly of a position and speed controlled writing system.

The system is made by means of a measuring amplifier a power amplifier and a servo potentiometer.

Furthermore the recorder has a paper drive circuit and a power supply.



Input Circuit

By means of the "Recording Mode" selector it is possible to choose between "DC Lin.", "DC Log" and "AC Log" input.

In the positions "AC Log" and "DC Log", the signal is fed via the Input potentiometer direct to the servopotentiometer, the output of which is controlled by the servoloop in order to have a constant level when the measuring amplifier and RMS detector are in balance.

In "DC Lin." and "DC Log" the input signal is fed through an electronic chopper, where the signal is converted to a 500 Hz squarewave signal.

In position "AC Log" the chopper generator is out of function, which means that V7 is conducting and V8 is nonconducting.

In position "DC Lin." the signal passed through an antilogarithmic amplifier V2-4 before the signal is fed to the servopotentiometer.

In this way a linear function of the Level Recorder is obtained.

The amplifier V1 is a × 7 amplifier and the off-set of V1 can be adjusted by means of P2 "DC Lin. Pos.".

Balanced Amplifier

The input to the balanced amplifier is made by two FET's V9, V10. One is connected to the chopper and one to ground.

Furthermore there are three IC amplifiers.

The resulting amplification is controlled by the combined AC and DC feedback, the frequency response of which is set through the "Writing Speed/LF Limit" selector.

RMS Rectifier

The signals from the balanced amplifier are fed through the capacitors C311, 312 to the rectifier bridge, then squared and averaged by two quasi RMS circuits the output of which are two symmetrically DC signals.

The averaging capacitors are variable by means of the "Writing Speed" selector.

The output of the RMS detectors are now compared to the ± 15 V reference voltages and the difference moves the Magnetic Drive System and the servopotentiometer until balance is obtained.

Limiter

In order to have the equal dynamic range for the 25 dB and the 50 dB servopotentiometer, the input to the output amplifier V18, must be changed.

This is done automatically when changing potentiometer. A selector on the potentiometer choose the correct attenuation from the RMS circuit. (R357, 358, 359 and 360).

When the amplifier is out of balance either the RMS voltage or the reference voltage controls the Magnetic Drive System. As the RMS rectifier is able to give the largest voltage a limiter Q107, 315, 316 is connected between the two channels. This gives the same error voltage on both channels, positive and negative respectively.

Another limiter Q317, 318 ensures that the Power Amplifier applies a constant voltage and acceleration even if the error voltage is high. When the amplifier is almost in balance, this limiter stops working and the servoloop takes over the control.

In order to avoid "overshooting" of the pen, P5 "Resolution" is able to reduce the amplification of the Power Amplifier.

Power Amplifier

The Power Amplifier is connected as a bridge, which means that the pair V19, V22 works together in one direction and the pair V20, V21 works in the other direction. This is done in order to obtain a driving voltage twice as high as a one stage amplifier would enable.

For an increasing voltage V20, V21 is used and for a decreasing voltage V19, V22 is activated.

The amplifier uses current feedback through R370, 374 or R371, 375, dependent of the current direction.

The voltage across the Drive Coil will maximum be V. Bat. — 2 V due to the voltage drop across the two transistors.

Magnet Drive System

A current through the system will due to the magnetic field around the coils, move the stylus and the slider for the servopotentiometer. A velocity coil next to the driving coil controls the feedback current to the Power Amplifier. This gives a constant speed depending of the "Writing Speed" selector and the "Velocity" potentiometer.

A compensation transformer in serial with the feedback eliminate the induction between the two coils in the system.

If no signal, or a very small signal is supplied to the "Input" the stylus will be at the end position. In this position a "Magnetic Limit Switch" provide that the amplifier first starts working when a positive going signal is supplied to the Power Amplifier. This is done in order to save the batteries.

Fi

Ext. Sync.

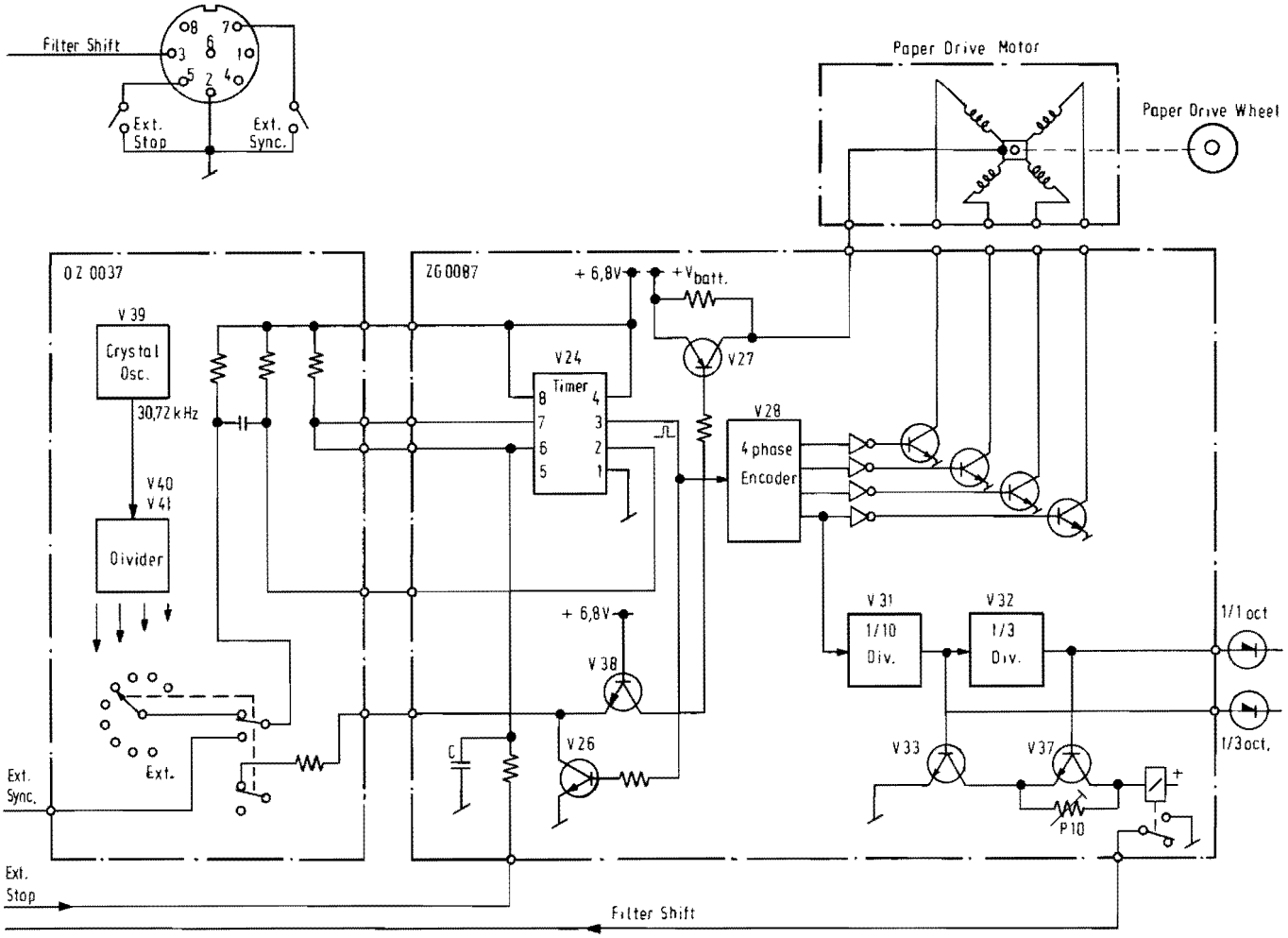
Ext. Stop

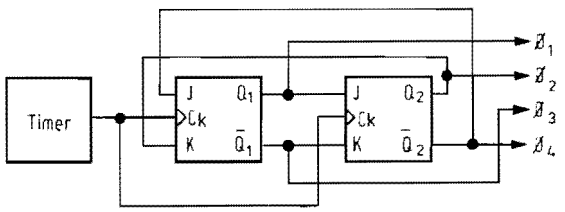
Paper D

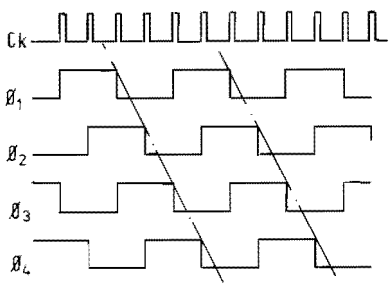
The pap
circuit c
timer I.C
rent of
pulses a
able fror

Filter Sh

By mear
shift pul







Paper Drive System

The paper is moved by means of a stepping motor. A 4-phase generating circuit controls the sequence of current pulses to the motor windings. A timer I.C. is connected as a one-shot providing an increased motor current of 2 ms duration, when the motor step is taking place. The timer pulses are used as clock input to the 4-phase encoder, and they are available from the 8 pin DIN socket for remote control applications.

The master clock is a 30,720 kHz crystal controlled oscillator and divider the output of which is 240 Hz. The frequency is further divided as selected by the Paper Speed switch to ensure the correct stepping frequencies. When the switch is in the "Ext." position the internal clock is disconnected and the timer can be externally triggered via the Remote Control socket.

Filter Shift

By means of P10 it is possible to switch between 1/1 oct. and 1/3 oct. shift pulses.

2.1. Input Amplifier

POWER: "On"
PEN DRIVE: "Off"
PAPER DRIVE: "Off"
RECORDING MODE: "AC Log"
SENSITIVITY: "10"
50 dB SERVOPOTENTIOMETER

Input signal 1 kHz, 100 mV RMS.
Connect an oscilloscope to C 311 (on ZE 0127, output of Balanced Ampl.)
Move the stylus to the point where the signal is just being clipped. (minimum 25 V pp).
Adjust P 4 "Balance" for symmetric clipping. (ZE 0127)

Connect the oscilloscope to C312 and check as above.

2.2. Vel. Feedback Compensation

POWER: "On"
PEN DRIVE: "On"
PAPER DRIVE: "Off"
RECORDING MODE: "DC Lin"
WRITING SPEED: "16 mm/s"
DC LIN POSITION: "5"

Move the pen by hand to one of the sides and let the pen return to neutral position.
If the deflection is unstable, adjust PII to a stable deflection

2.3 Paper Speed

a. POWER: "On"
PEN DRIVE: "On"
PAPER DRIVE: "Off"
PAPER SPEED: "1 mm/s"

Activate "Paper Drive" and let the paper run for 60 s.
Check the length of the paper movement: 60 mm ± 1 mm

b. PAPER SPEED: "10 mm/s"

Activate "Paper Drive" and let the paper run for 15 s.
Paper movement: 150 mm ± 7,5 mm

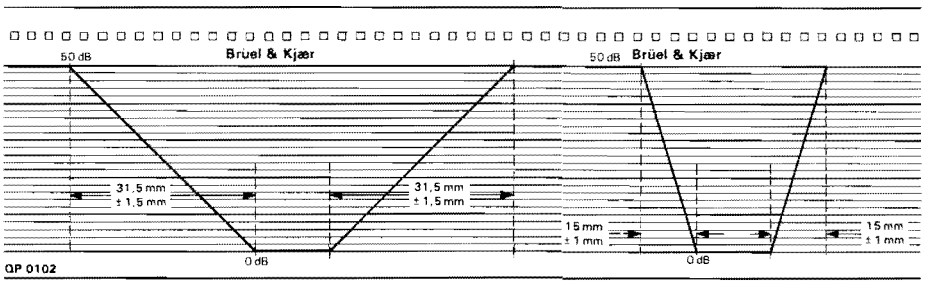
2.4 Sensitivity

POWER: "On"
PEN DRIVE: "On"
PAPER DRIVE: "Off"
RECORDING MODE: "AC Log"
SENSITIVITY: "10"
50 dB SERVOPOTENTIOMETER
WRITING SPEED: "100 mm/s"

Adjust the input signal at 1 kHz to the 0 dB line on the paper.

Maximum input voltage 5 mV RMS.
If more, check the mechanical friction item 3.2.

2.5 Writing Speed



a. POWER: "On"
PEN DRIVE: "On"
PAPER DRIVE: "Off"
RECORDING MODE: "AC Log"
SENSITIVITY: "10"
50 dB SERVOPOTENTIOMETER
PAPER SPEED: "10 mm/s"
WRITING SPEED: "16 mm/s"

Input signal 1 kHz.
Adjust the input voltage for a deflection of 50 dB on the paper.
Increase the input voltage 10 dB.
Activate "Paper Drive" and remove the input signal.
Note the paper length from the stylus passing the 50 dB line until it reach 0 dB:
31,5 mm ± 1,5 mm.
Connect the input signal again and note the length from the stylus passing 0 dB line to it reach 50 dB:
31,5 mm ± 1,5 mm.

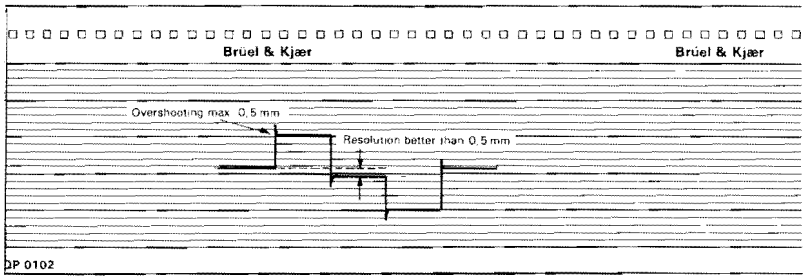
Before any adjustments check item 2.3

Adjust P 6 "Vel." for correct speed. (ZE 0127)
Adjust P 7 "Zero" for symmetry. (ZE 0127)

b. PAPER SPEED to "30 mm/s"
WRITING SPEED to "100 mm/s"

Check the writing speed as mentioned above for "16 mm/s", 15 mm ± 1 mm.

2.6. Overshoot and Resolution



a. POWER: "On"
PEN DRIVE: "On"
RECORDING MODE: "AC Log"
SENSITIVITY: "10"
50 dB SERVOPOTENTIOMETER
PAPER SPEED: "3 mm/s"
WRITING SPEED: "250 mm/s"
PAPER DRIVE: "On"

Input signal 1 kHz.
Adjust the input voltage for 20 dB deflection on the paper.
Increase the input voltage in step 10 dB, and check the overshoot: Maximum 0,5 mm.
If necessary adjust P5 "Resolution". (ZE 0127)

Decrease the input voltage 10 dB and check the resolution.
Resolution should be better than 0,5 mm.
If necessary adjust P5 and repeat item 2.5a, 2.5b, 2.6a

b. PAPER SPEED to "1 mm/s"
WRITING SPEED to "16 mm/s"

Check overshoot and resolution as mentioned above.
Tolerance. ± 0,5 mm.

2.7. Frequency Response

POWER: "On"
PEN DRIVE: "On"
RECORDING MODE: "AC Log"
SENSITIVITY: "10"
50 dB POTENTIOMETER
PAPER SPEED: "3 mm/s"
WRITING SPEED: "100 mm/s"
PAPER DRIVE: "On"

Input signal 1 kHz adjusted for 20 dB deflection on the paper.

Vary the frequency between 10 Hz and 20 kHz. 3.1
Deflection: 20 dB ± 1 dB.

2.8. DC Logarithmic

a. POWER: "On"
PEN DRIVE: "On"
RECORDING MODE: "AC Log"
SENSITIVITY: "10"
50 dB POTENTIOMETER
PAPER SPEED: "3 mm/s"
WRITING SPEED: "100 mm/s"
PAPER DRIVE: "On"

Apply an AC voltage of 750 mV RMS 1 kHz to the "Signal Input".
Note the deflection on the paper. 3.2

b. RECORDING MODE: "DC Log"

Apply a DC voltage of 1,5 V DC to the "Signal Input"
Deflection as noted above.
Tolerance: ± 1 dB.

Check the sensitivity at 0 dB deflection: maximum 10 mV DC.

2.9 DC Linear

POWER: "On"
PEN DRIVE: "On"
PAPER DRIVE: "Off"
RECORDING MODE: "DC Lin."
SENSITIVITY: "10"
50 dB POTENTIOMETER
WRITING SPEED: "100 mm/s"

Short circuit the "Input".

Check if it is possible to move the stylus between 0 dB and 50 dB on the paper by means of "DC Lin. Position".

DC LIN POSITION to "10"

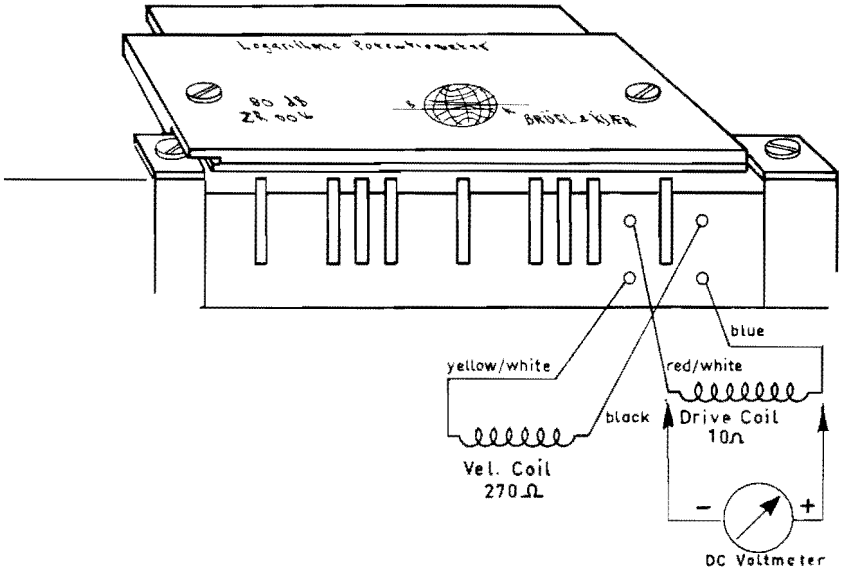
Check the off-set voltage at V4 pin 6: 0 V ± 5 mV
If necessary adjust P9

2.10 Battery Indicator

POWER: "On"
PEN DRIVE: "Off"
PAPER DRIVE: "Off"
RECORDING MODE: "DC Lin"
SENSITIVITY: "10"
50 dB POTENTIOMETER
WRITING SPEED: "100 mm/s"

Check that the Battery Indicator deflect to the point between the red and the green area, for a battery voltage of 6 V. (across C 213)

If not adjust P 8 "Battery" (OZ 0006).



3.1 Magnetic Drive System

POWER: "On"
PEN DRIVE "On"
PAPER DRIVE "Off"
RECORDING MODE: "AC Log"
SENSITIVITY "10"
50 dB SERVOPOTENTIOMETER
WRITING SPEED "100 mm/s"

Connect a DC voltmeter across the Drive Coil (ref. above).

Adjust the input signal at 1 kHz to 20 dB deflection on the paper.

Move the stylus by the hand and check the voltage across the Drive Coil.
50 dB position: + 4 V ± 1 V.
0 dB position: -4 V ± 1 V.

3.2 Writing System

POWER: "On"
PEN DRIVE: "On"
PAPER DRIVE "Off"
RECORDING MODE: "AC Log"
SENSITIVITY "10"
50 dB SERVOPOTENTIOMETER
WRITING SPEED: "16 mm/s"

DC voltmeter connected across the Drive Coil.

Switch the input signal at 1 kHz between 0 V and 10 V.
Check the voltage across the coil.
Moving from 0 to 50 dB: – 1 V ± 0,4 V.
Moving from 50 to 0 dB: + 1 V ± 0,4 V.

If the voltage is higher try to clean the Writing System for oil, dust, ect. If this does not help, the system must be send to the factory for repair.

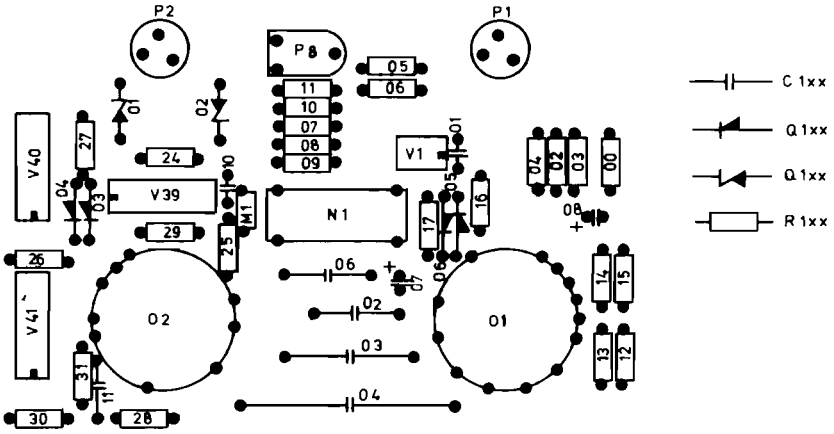
Dismantling
The Writing System can be removed as follows:
Remove the Servo Potentiometer.
Remove the 6 screws marked "A" (refered to page 0 — 2).
Remove the rear plate.
Lower the printed circuit board ZE 0127 and ZG 0087. Now the system can be carefully removed.

Assembling
As mentioned above in reverse order.
Check that the Magnetic Limit Switch is working between the 0 dB position and the mechanical stop

Layout Diagram with Parts List

OZ 0037

Selector Board



Viewed from the component side

C 101	Ceramic	220 pF/400 V	CK 2220	R 100	Carbon	1/4 W	5%	12 Ω	RB 1120
C 102	Electrolytic	4,7 µF/ 25 V	CE 0464	R 102	Metal	-	1%	140 kΩ	RF 5140
C 103	-	10 µF/ 25 V	CE 0458	R 103	-	-	-	100 kΩ	RF 5100
C 104	-	47 µF/ 25 V	CE 0463	R 104	-	-	-	1 MΩ	RF 6100
C 106	Polycarbonate	1 µF/ 63 V	CS 0808	R 105	-	-	-	100 kΩ	RF 5100
C 107	Tantalum	3,3 µF/ 16 V	CF 0014	R 106	-	-	-	3,74 kΩ	RF 3374
C 108	-	10 µF/ 16 V	CF 0059	R 107	-	-	-	1 MΩ	RF 6100
C 110	Ceramic	22 pF/400 V	CK 1220	R 108,109	Carbon	-	5%	8,2 kΩ	RB 3820
C 111	Polyester	22 nF/200 V	CS 0400	R 110,111	-	-	-	10 kΩ	RB 4100
				R 112	Metal	-	1%	806 Ω	RF 2806
				R 113	-	-	-	1,21 kΩ	RF 3121
M 1	X-tal	2072 Hz	MB 0025	R 114	-	-	-	3,01 kΩ	RF 3301
				R 115	-	-	-	7,50 kΩ	RF 3750
				R 116	-	-	-	165 kΩ	RF 5165
N 1	Recording Mode		NN 0033	R 117	Carbon	-	5%	22 kΩ	RB 4220
				R 124	-	-	-	10 MΩ	RB 7100
				R 125	-	-	-	150 kΩ	RB 5150
O 1	Writing Speed/LF Limit		OH 3091	R 126,127	-	-	-	68 kΩ	RB 4680
O 1	Wafer for above		OD 1052	R 128	Metal	-	1%	54,9 kΩ	RF 4549
O 2	Paper Speed		OH 3093	R 129	Carbon	-	5%	180 Ω	RB 2180
O 2	Wafer for above		OD 1070	R 130,131	-	-	-	10 kΩ	RB 4100

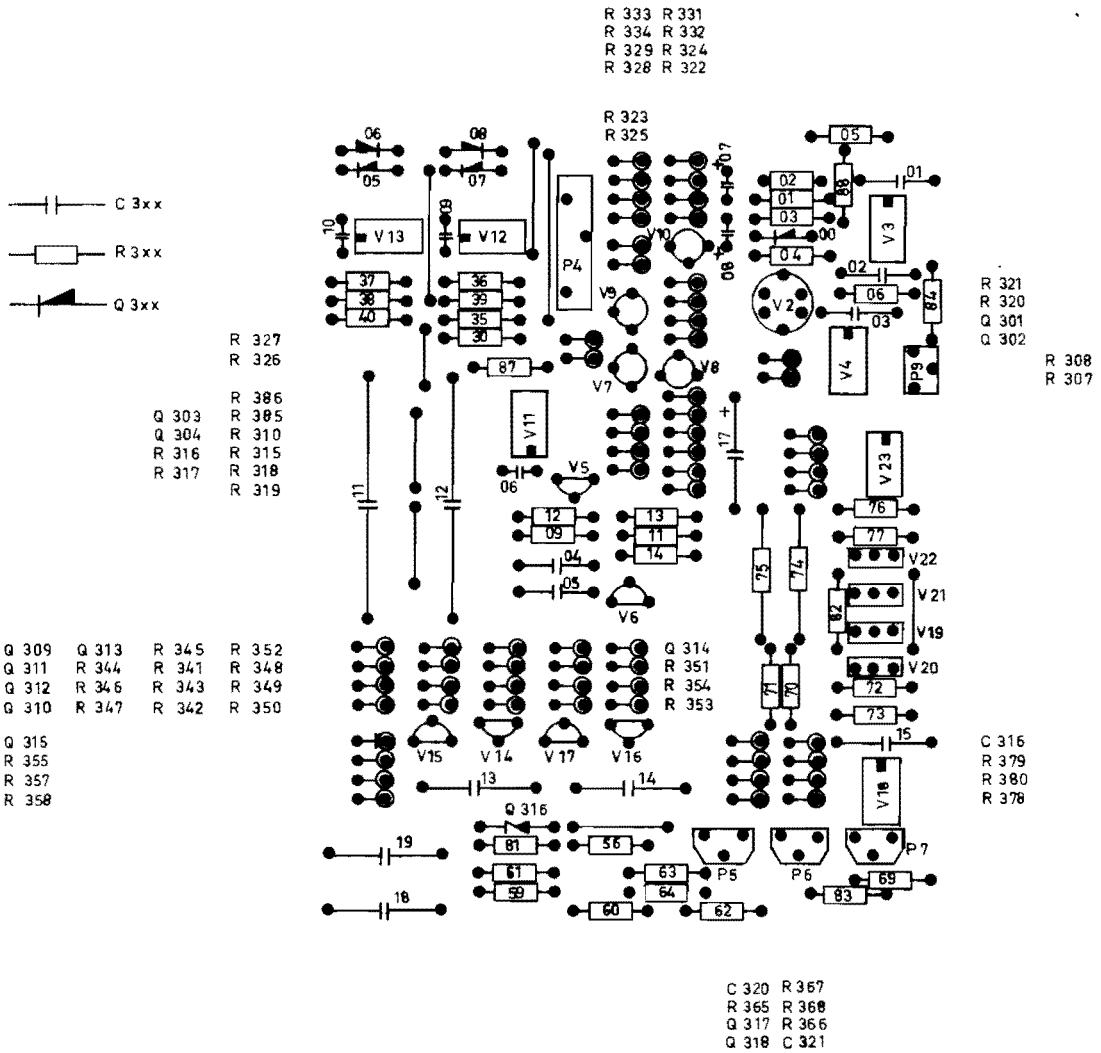
P 1	Sensitivity	Conductive Plast	50 kΩ	PD 3510	V 1	Op. Amp.	LM308	VE 0046
P 2	DC Lin. Pos.	- -	100 kΩ	PD 4111	V 39	14-stage Counter/Divider and Osc.	4060	VD 2064
P 8	Battery	Cermet	22 kΩ	PG 3221	V 40,41	2 × BCD Counter/Divider	4518	VD 2036

Q 101,102	Zener ZG6,8	6,0-7,5 V/0,25 W	QV 1106	Printed Circuit Board	XC 1744
Q 103-106	Silicon 1N4148	75 V/75 mA	QV 0216	8-pin Socket	JJ 0804

Layout Diagram with Parts List

ZE 0127

Amplifier Board



Viewed from the component side

CIRCUIT DIAGRAM REF.	COMPONENT TYPE				STOCK REF.
C 301	Polystyrene			180 pF/ 63 V	CT 1310
C 302	-			82 pF/ 63 V	CT 0504
C 303	-			180 pF/ 63 V	CT 1310
C 304,305	Polyester			22 nF/250 V	CS 0400
C 306	Ceramic			3,3 pF/250 V	CK 0331
C 307,308	Tantalum			4,7 µF/ 10 V	CF 0018
C 309,310	Ceramic			3,3 pF/250 V	CK 0331
C 311,312	Electrolytic			47 µF/ 30 V	CE 0463
C 313,314	Polycarbonate			1,5 µF/ 63 V	CS 0414
C 315	Polystyrene			820 pF/ 63 V	CT 1532
C 316	-			82 pF/ 63 V	CT 1162
C 317	Electrolytic			50 µF/ 6,4 V	CE 0204
C 318,319	Polycarbonate			1 µF/ 63 V	CS 0808
C 320,321	Polyester			10 nF/250 V	CS 0553
P 4	Balance	Cermet	lin.	10 kΩ	PG 3112
P 5	Resolution	-	-	100 kΩ	PG 4112
P 6	Velocity	-	-	2 kΩ	PG 2212
P 7	Zero	-	-	20 kΩ	PG 3209
P 9	Off-set	-	-	50 kΩ	PG 3515

CIRCUIT DIAGRAM REF.	COMPONENT TYPE				STOCK REF.
Q 300	Schot.	HP2811		15 V/20 mA	QV 5000
Q 301,302	Si.	1N4148		75 V/75 mA	QV 0216
Q 303,304	-	1N4004		400 V/1 A	QV 0237
Q 305-315	-	1N4148		75 V/75 mA	QV 0216
Q 316	Ze.	ZF4,3		4,0-4,6 V/0,4 W	QV 1110
Q 317,318	Si.	1N4004		400 V/1 A	QV 0237
R 301	Metal	1/4 W	1%	15,4 kΩ	RF 4154
R 302	NTC			15 kΩ	RN 0010
R 303	Metal	1/4 W	1%	34,8 kΩ	RF 4348
R 304,305	-	-	-	301 kΩ	RF 5301
R 306	-	-	-	2,00 kΩ	RF 3200
R 307,308	-	-	-	20 kΩ	RF 4200
R 309	Carbon		5%	2,7 kΩ	RB 3270
R 310	-	-	-	3,9 kΩ	RB 3390
R 311	-	-	-	82 kΩ	RB 4820
R 312	Carbon	1/4 W	5%	10 kΩ	RB 4100
R 313	-	-	-	82 kΩ	RB 4820
R 314	-	-	-	10 kΩ	RB 4100
R 315	-	-	-	3,9 kΩ	RB 3390
R 316-319	-		-	27 kΩ	RB 4270

continued

CIRCUIT DIAGRAM REF.	COMPONENT TYPE				STOCK REF.
R 320	Carbon	1/4 W	5%	10 kΩ	RB 4100
R 321	-	-	-	1 MΩ	RB 6100
R 322	Metal	-	1%	10,0 kΩ	RF 4100
R 323	-	-	-	24,9 kΩ	RF 4249
R 324	-	-	-	10,0 kΩ	RF 4100
R 325-327	-	-	-	24,9 kΩ	RF 4249
R 328,329	-	-	-	301 kΩ	RF 5301
R 330	Carbon	-	5%	1 MΩ	RB 6100
R 331,332	Metal	-	1%	976 Ω	RF 2976
R 333,334	-	-	-	301 kΩ	RF 5301
R 335-338	-	-	-	24,9 kΩ	RF 4249
R 339,340	Carbon	-	5%	1 MΩ	RB 6100
R 341	Metal	-	1%	7,50 kΩ	RF 3750
R 342	-	-	-	4,22 kΩ	RF 3422
R 343	-	-	-	5,49 kΩ	RF 3549
R 344	-	-	-	25,5 kΩ	RF 4255
R 345	-	-	-	20,5 kΩ	RF 4205
R 346	-	-	-	11,0 kΩ	RF 4110
R 347	-	-	-	2,67 kΩ	RF 3267
R 348	-	-	-	7,50 kΩ	RF 3750
R 349	-	-	-	4,22 kΩ	RF 3422
R 350	-	-	-	5,49 kΩ	RF 3549
R 351	-	-	-	25,5 kΩ	RF 4255
R 352	-	-	-	20,5 kΩ	RF 4205
R 353	-	-	-	11,0 kΩ	RF 4110
R 354	-	-	-	2,67 kΩ	RF 3267
R 355,356	-	-	-	13,3 kΩ	RF 4133
R 357	-	-	-	5,11 kΩ	RF 3511
R 358,359	-	-	-	18,2 kΩ	RF 4182
R 360	-	-	-	5,11 kΩ	RF 3511
R 361,362	-	-	-	100 kΩ	RF 5100

CIRCUIT DIAGRAM REF.	COMPONENT TYPE				STOCK REF.
R 363,364	Carbon	1/4 W	5%	33 kΩ	RB 4330
R 365,366	-	-	-	1 MΩ	RB 6100
R 367	Metal	-	1%	100 kΩ	RF 5100
R 368	-	-	-	90,9 kΩ	RF 4909
R 369	Carbon	-	5%	1 MΩ	RB 6100
R 370,371	-	-	-	2,2 MΩ	RB 6220
R 372	-	-	-	2,2 kΩ	RB 3220
R 373	Metal	-	1%	100 kΩ	RF 5100
R 374,375	Wire	2 W	10%	0,5 Ω	RO 1203
R 376	Metal	1/4 W	1%	100 kΩ	RF 5100
R 377	Carbon	-	5%	2,2 kΩ	RB 3220
R 378	Metal	-	1%	49,9 kΩ	RF 4499
R 379	-	-	-	100 kΩ	RF 5100
R 380	-	-	-	33,2 kΩ	RF 4332
R 381	Carbon	-	5%	6,8 kΩ	RB 3680
R 382,383	-	-	-	100 kΩ	RB 5100
R 384	-	1/8 W	5%	10 MΩ	RB 7100
R 385-387	-	-	10%	1 MΩ	RB 6100
R 388	Metal	1/4 W	1%	402 kΩ	RF 5402

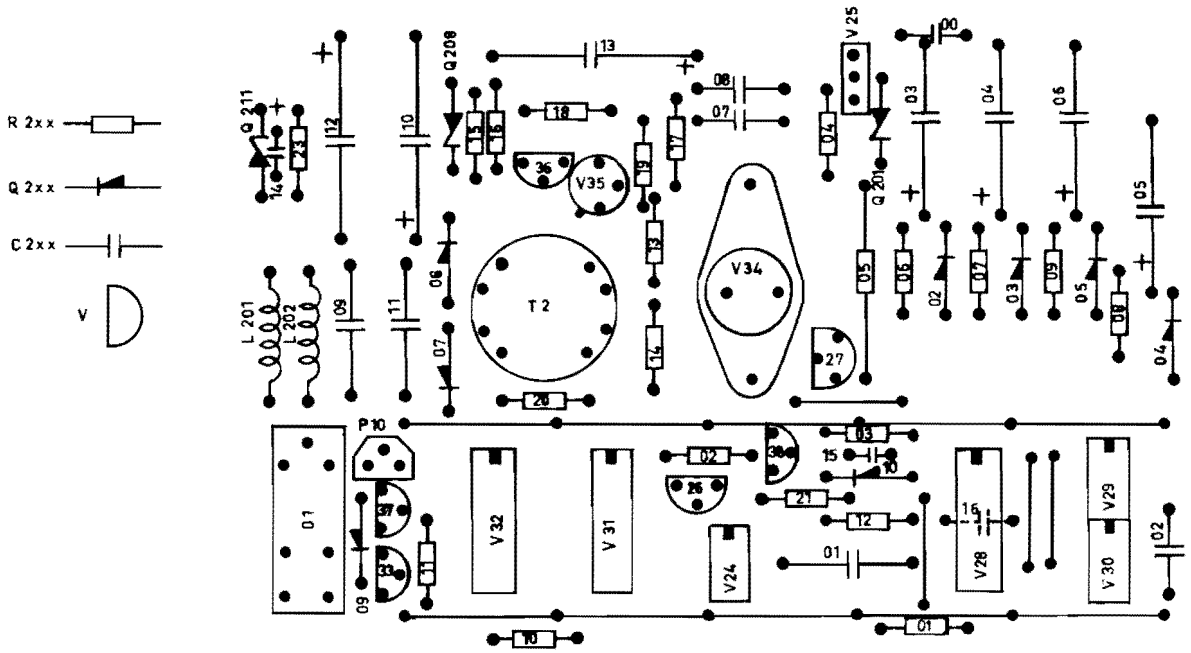
V 2	Silicon dual	NPN	2N2453	VB 0551
V 3,4	Op. Amp.		301AN	VE 0046
V 5,6	Silicon	NPN	BC182	VB 0055
V 7,8	FET	N	E102	VB 1028
V 9,10	FET pair	N	E102	VB 1013
V 11-13	Op. Amp.		301AN	VE 0017
V 14,15	Silicon	NPN	BC182	VB 0055
V 16,17	-	PNP	BC213	VB 0049
V 18	Op. Amp.		301AN	VE 0017
V 19	Silicon	NPN	BD675A	VB 0550
V 20	-	PNP	BD676A	VB 0110
V 21	Silicon	NPN	BD675A	VB 0550
V 22	-	PNP	BD676A	VB 0110
V 23	Op. Amp.		301AN	VE 0017

	Printed Circuit Board	XC 1059

Layout Diagram with Parts List

ZG 0087

Power Supply



Viewed from the component side

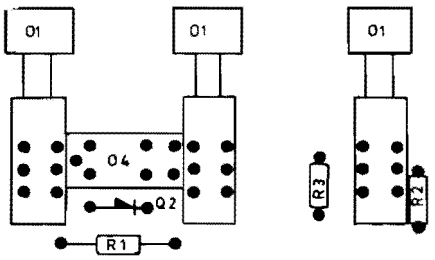
CIRCUIT DIAGRAM REF.	COMPONENT TYPE			STOCK REF.
C 200	Ceramic		47 nF/ 30 V	CK 4470
C 201	Polystyrene		33 nF/ 63 V	CT 1577
C 202	Polyester		22 nF/250 V	CS 0400
C 203-206	Electrolytic		100 µF/ 6 V	CE 0207
C 207	Polyester		10 nF/250 V	CS 0403
C 208	-		22 nF/250 V	CS 0400
C 209	Electrolytic		4,7 µF/ 63 V	CE 0200
C 210	-		100 µF/ 16 V	CE 0310
C 211	-		4,7 µF/ 63 V	CE 0200
C 212,213	-		100 µF/ 16 V	CE 0310
C 214	Tantalum		10 µF/ 16 V	CF 0059
C 215	Ceramic		1 nF/400 V	CK 3101
C 216	-		4,7 nF/ 50 V	CK 9102
L 201,202	Filter Choke		30 µH	LJ 0008
O 1	Filter Shift Relay			OC 0058
P 10	Filter Shift	Cermet	100 kΩ	PG 4105
Q 201	Ze.	ZG5,6	5,0-6,2 V/5 mA	QV 1105
Q 202-205	Si.	1N4004	400 V/1 A	QV 0237
Q 206,207	-	1N4148	75 V/75 mA	QV 0216
Q 208	Ze.	ZF9,1	8,5-9,6 V/5 mA	QV 1109
Q 209	Si.	1N4004	400 V/1 A	QV 0237
Q 210	Ge.	OA47	25 V/110 mA	QV 0094
Q 211	Ze.	ZG6,8	6,0-7,5 V/ 5 mA	QV 1008

CIRCUIT DIAGRAM REF.	COMPONENT TYPE				STOCK REF.
R 201	Carbon	1/4 W	5%	1 kΩ	RB 3100
R 202	-	-	-	270 Ω	RB 2270
R 203	-	-	-	470 Ω	RB 2470
R 204	-	-	-	270 Ω	RB 2270
R 205	Wire	4 W	10%	56 Ω	RX 0319
R 206-209	Metal	1/4 W	1%	6,81 Ω	RF 0681
R 210	Carbon	1/4 W	5%	100 Ω	RB 2100
R 211	-	-	-	1 kΩ	RB 3100
R 212	-	-	-	5,6 kΩ	RB 3560
R 213	-	-	-	10 Ω	RB 1100
R 214	-	-	-	8,2 kΩ	RB 3820
R 215	Metal	-	1%	18,2 kΩ	RF 4182
R 216	-	-	-	40,2 kΩ	RF 4402
R 217	Carbon	-	5%	56 kΩ	RB 4560
R 218	-	-	-	1 kΩ	RB 3100
R 219	-	-	-	120 Ω	RB 2120
R 220	-	-	-	1 kΩ	RB 3100
R 221	-	-	-	6,8 kΩ	RB 3680
R 223	-	-	-	820 Ω	RB 2820
T 2	Converter Transformer				LB 0836
V 24	Timer			NE555V	VD 0100
V 25	Silicon	NPN		2N4922	VB 0063
V 26	Silicon	NPN		BC182	VB 0055
V 27	Silicon	PNP		2N4403	VB 0084
V 28	Dual M-S-J-K-F-F			SN7473N	VD 0017
V 29,30	Dual AND Driver			SN75451P	VD 0043
V 31	Decade			SN7490N	VD 0013
V 32	Dual M-S-J-K-F-F			SN7473N	VD 0017
V 33	Silicon	NPN		BC182	VB 0055
V 34	Germanium	PNP		AD162	VB 0078
V 35	FET	N		NF510	VB 1036
V 36-38	Silicon	NPN		BC182	VB 0055
	8 pin Socket for Dual-in-line				JJ 0804
	Printed Circuit Board				XC 1060

Miscellaneous

	"Remote Control" DIN socket		JJ 0709
	"Signal Input" BNC socket		JJ 0130
	Clutch disc.		DS 0170
	"Magnetic Limit Switch" reed relay		OC 0025
	"Filter Shift Relay" mini relay		OC 0058
	Stepper motor		UM 1023
	Magnetic Drive System		UA 2003
	Leather Case		KE 0135
	Hand Grip		DH 0006
N 2	"Polarity" switch		NN 0025
	Batteries		QB 0004
	Ni-Cd cell		QB 0008
	Battery Box.		ZG 0106
	Range Potentiometer	25 dB	ZR 0015
	Range Potentiometer	50 dB	ZR 0016
	Sapphire stylus		DH 2003
	Battery Indicator	400 μA	IM 2616
Q 3-5	LED		QV 4004

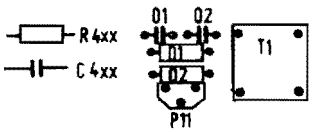
ZH 0114



viewed from the printed circuit board

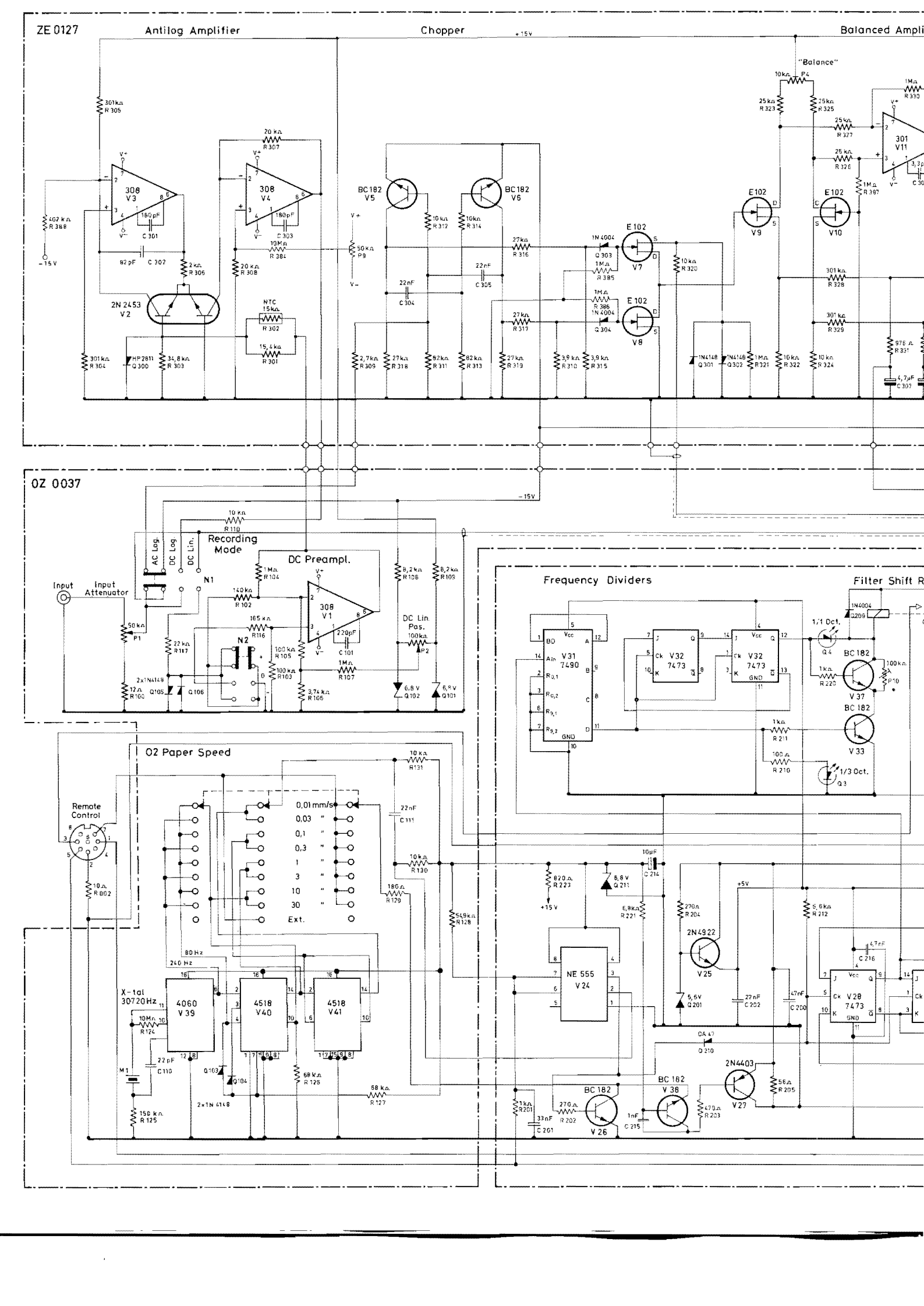
O 1	Pen Drive switch Power switch Paper Drive switch				OJ 0045
O 4	Mini-Relay			6 V	OC 0058
Q 2	Silicon 1N4004			400 V/1 A	QV 0237
R 1	Wire	5 W	10%	8,2 Ω	RO 1207
R 2	Carbon	1/4 W	5%	10 Ω	RB 1100
R 3	-	-	-	1 kΩ	RB 3100
	Printed Circuit Board				XC 1551

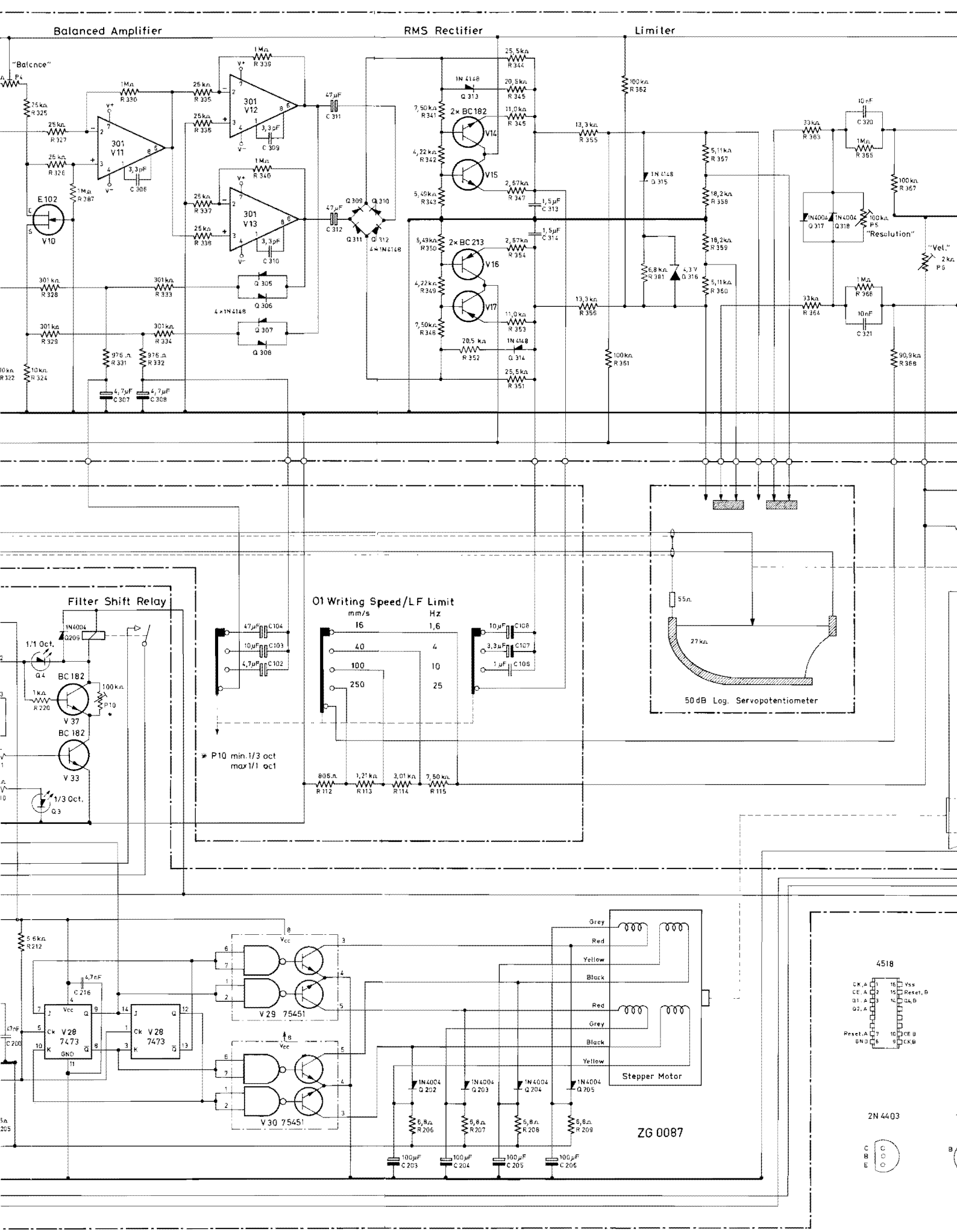
ZS 0305

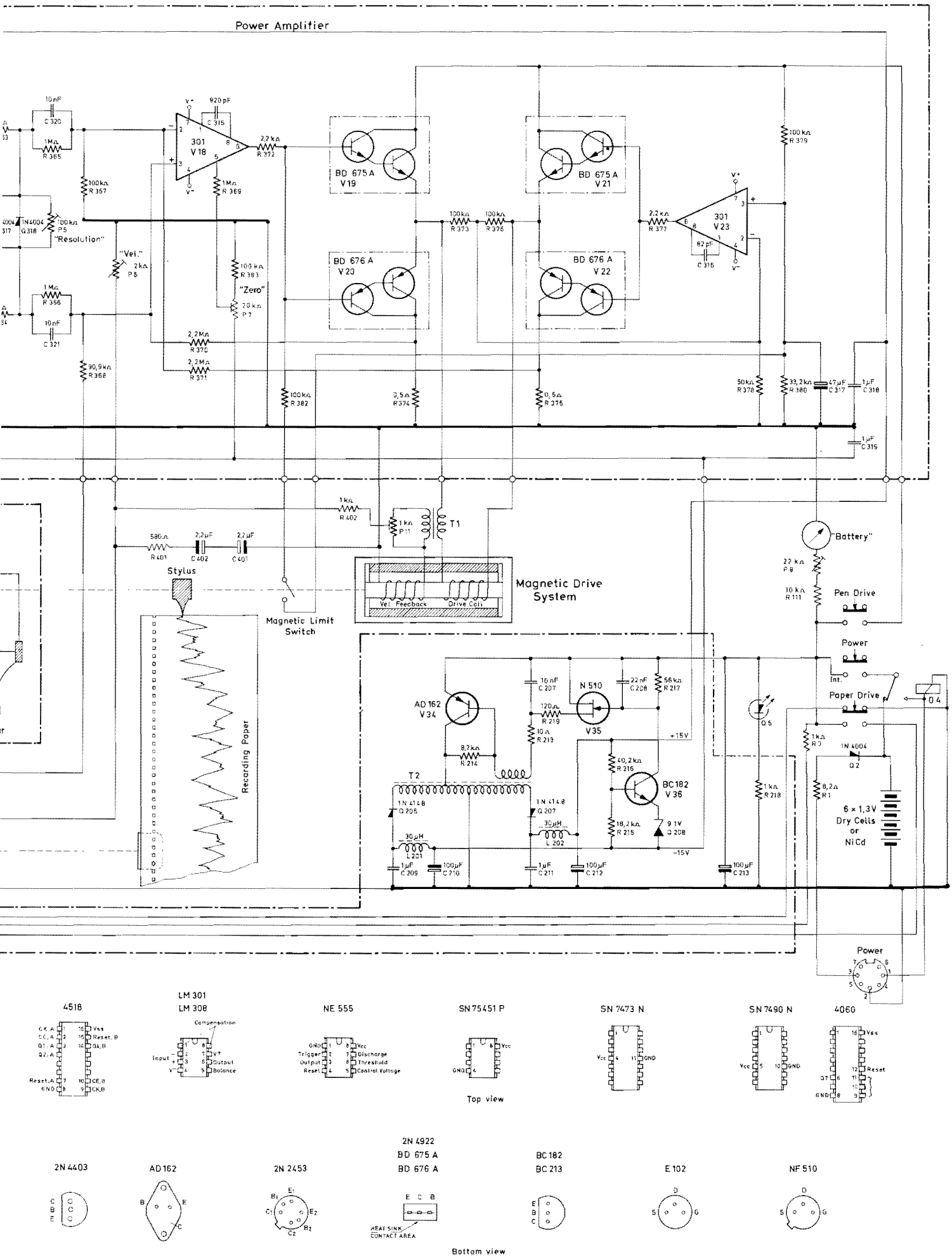


viewed from the printed circuit board

C 401,402	Tantalum	2,2 μF/35 V			CF 0022
P 11	Trimmer	cermet	Lin	1 kΩ	PG 2114
R 401	Carbon	1/4 W	5%	680 Ω	RB 2680
R 402	-	-	-	1 kΩ	RB 3100
T 1	Transformer				LB 0845
	Printed Circuit Board				XC 1434


ZE 0127
Antilog Amplifier
Chopper
Balanced Ampli
+15V
-15V
"Balance"
301kΩ R 305
20 kΩ R 307
402 kΩ R 388
308 V3
308 V4
180pF
C 301
C 303
82 pF C 302
2 kΩ R 306
20 kΩ R 308
10MΩ R 384
2N 2453 V2
NTC 15kΩ R 302
15,4kΩ R 301
301kΩ R 304
HP2811 Q 300
34,8kΩ R 303
BC182 V5
BC182 V6
10kΩ R 312
10kΩ R 314
50kΩ P9
22nF C 304
22nF C 305
27kΩ R 316
27kΩ R 317
1N 4004 Q 303
1MΩ R 385
1MΩ R 386
1N 4004 Q 304
E102 V7
E102 V8
10kΩ R 320
2,7kΩ R 309
27kΩ R 318
82kΩ R 311
82kΩ R 313
27kΩ R 319
3,9kΩ R 310
3,9kΩ R 315
1N4148 Q 301
1N4148 Q 302
1MΩ R 321
10kΩ R 322
10kΩ R 324
10kΩ P4
25kΩ R 323
25kΩ R 325
25kΩ R 327
25kΩ R 326
1MΩ R 387
1MΩ R 330
301 V11
E102 V9
E102 V10
301kΩ R 328
301kΩ R 329
976Ω R 331
4,7µF C 307
OZ 0037
10 kΩ R 110
Recording Mode
AC Log.
DC Log
DC Lin.
DC Preampl.
Input
Input Attenuator
N1
N2
140kΩ R 102
1MΩ R 104
165kΩ R 116
100kΩ R 105
100kΩ R 103
1MΩ R 107
3,74kΩ R 106
308 V1
220pF C 101
50kΩ P1
22kΩ R 117
12Ω R 100
2x1N4148 Q 105
Q 106
8,2kΩ R 108
8,2kΩ R 109
DC Lin. Pos. 100kΩ P2
6,8 V Q 102
6,8 V Q 101
Frequency Dividers
Filter Shift R
V31 7490
V32 7473
V32 7473
V28 7473
1N4004 Q 209
1/1 Oct. Q 4
1/3 Oct. Q 3
BC 182 V 37
BC 182 V 33
1kΩ R 220
100kΩ P10
1kΩ R 211
100Ω R 210
02 Paper Speed
Remote Control
10Ω R 002
10 kΩ R 131
22nF C 111
10kΩ R 130
180Ω R 129
54,9kΩ R 128
0,01 mm/s
0,03 "
0,1 "
0,3 "
1 "
3 "
10 "
30 "
Ext.
80 Hz
240 Hz
X-tal 30720Hz
4060 V 39
4518 V40
4518 V41
10MΩ R 124
22 pF C 110
M 1
150 kΩ R 125
68 kΩ R 126
68 kΩ R 127
Q 103
Q 104
2x1N 4148
820Ω R 223
6,8 V Q 211
6,8kΩ R 221
10µF C 214
NE 555 V 24
270Ω R 204
2N4922 V 25
5,6 V Q 201
+5V
5,6kΩ R 212
4,7nF C 216
22nF C 202
47nF C 200
QA 47 Q 210
2N4403 V 27
56Ω R 205
BC 182 V 26
BC 182 V 38
1kΩ R 201
270Ω R 202
33nF C 201
1nF C 215
470Ω R 203


Balanced Amplifier
RMS Rectifier
Limiter
"Balance"
"Resolution"
"Vel."
Filter Shift Relay
01 Writing Speed/LF Limit
mm/s
Hz
50dB Log. Servopotentiometer
* P10 min.1/3 oct
max1/1 oct
Stepper Motor
ZG 0087
2N 4403
4518


Power Amplifier
301 V18
BD 675 A V19
BD 675 A V21
BD 676 A V20
BD 676 A V22
301 V23
"Resolution"
"Vel."
"Zero"
"Battery"
Stylus
Magnetic Limit Switch
Magnetic Drive System
Vel. Feedback
Drive Coil
Recording Paper
Pen Drive
Power
Int.
Paper Drive
AD 162 V34
N 510
V35
BC 182 V36
9,1 V
6 x 1,3 V Dry Cells or NiCd
+15 V
-15 V
T1
T2
4518
LM 301
LM 308
NE 555
SN 75451 P
SN 7473 N
SN 7490 N
4060
Top view
2N 4403
AD 162
2N 2453
2N 4922
BD 675 A
BD 676 A
BC 182
BC 213
E 102
NF 510
Bottom view
859025-25-03-80-2306